DIGITAL CARTOGRAPHY OF MARS

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Mars Medium-Resolution Digital Image Model:

A medium-resolution Digital Image Model (DIM) of Mars is being compiled [1]. A DIM is a mosaic of radiometrically corrected, photometrically modelled spacecraft images displaying accurate reflectance properties at uniform resolution, and geometrically tied to the best available control. The Mars medium-resolution DIM contains approximately 4700 Viking Orbiter image frames that were used to compile the recently completed 1:2,000,000-scale controlled photomosaic series of Mars. This DIM provides a planimetric control base to which all other Mars maps will be registered. A similar control base of topographic elevations (Digital Terrain Model, or DTM) is also being compiled [2]. These poducts are scheduled for completion in 1989.

The DIM and DTM databases are, in effect, sets of bins whose locations are defined by latitude and longitude coordinates. Each bin contains a coded value for the reflectance (in the case of DIM's) or the elevation (in DTM's) of the Martian surface at that point. Map products are made from the models by moving the values in the bins to rectangular coordinates specified by whatever map projection has been selected and by writing the array as a digital image.

The reflectance at each bin (i.e., the pixel location in the DIM) is derived as a function of radiometric camera sensitivity, surface properties, and illumination geometry. The presence of some visible seams between image frames in the mosaics is a result of the fact that each of these parameters is imperfectly known.

Geometric positions of images are controlled by the Rand control net [3], by the topographic control net [4], and by adjustment of each frame for optimum fit to surrounding images. Once the position of each frame is adopted, a revised camera orientation matrix is computed and stored so that future geometric projections will be repeatable. Any image in the resulting digital mosaic becomes a valid control point for mosaics at both higher and lower resolutions. Points defined in the original control nets will not be used to control future mosaics, because their spacing is inadequate for high-resolution mosaics and because the images by which they are defined are shifted slightly in the final compilation.

Mars High-Resolution Digital Image Models:

High-resolution DIM's of Mars are being compiled with Viking Orbiter images to support the recently announced 1:500,000-scale Mars geologic mapping program. A total of 110 controlled photomosaics was previously prepared in the Mars Transverse Mercator (MTM) format at 1:500,000 scale by manual methods; similar controlled mosaicking will now be done digitally. Images in these mosaics commonly have resolutions of 10 to 50 m/pixel, whereas the medium-resolution DIM described above is being compiled at a uniform resolution of approximately 230 m/pixel. The high-resolution DIM's will cover areas

of scientific interest where existing data support the mapping; there is no intention to map the entire planet at these resolutions.

High-resolution DIM's have high relative planimetric accuracies because individual frame positions are adjusted by image-matching. Absolute positional accuracy, however, is not commensurate with the resolution of the mosaics for two primary reasons: (1) the medium-resolution DIM used as a control base is itself tied to a control net that has standard errors of approximately 5 km, and (2) images in the mosaic have much higher resolution (commonly 20 times higher) than the base mosaic, resulting in large image-placement ambiguities. An unfortunate result of this condition is that high-resolution mosaics compiled during one time period may not join adjacent mosaics compiled during another time period. There are neither data nor resources to remedy this condition by compiling a high-resolution control net of Mars.

High-resolution DIM's can be compiled only after the medium-resolution segments in which they lie are complete, because of the requirement for control. Compilation priorities are defined by scientific interest in particular areas and by operational efficiency. Priority compilation of specific areas may be requested through the Planetary Cartography Working Group (PCWG).

Digital files containing the high-resolution image mosaics will be distributed to the Regional Planetary Image Facilities. Hard-copy mosaics will be made on the MTM format and published at 1:500,000 scale.

References

[1] Batson, R.M., 1986, Digital image models of planetary surfaces: Lunar and Planetary Science Conference, Seventeenth, Abstracts, Part 1, March 17-21, Houston, p. 34-35.

[2] Wu, S.S.C., and Howington, Annie-Elpis, 1986, A Mars digital terrain model and sample correlation with a Mars digital image model: Reports of the Planetary Geology and Geophysics Program-1985, National Aeronautics and Space Administration Technical Memorandum 88383, p. 608-611.

[3] Davies, M.E., 1986, The control network of Mars: October, 1985: Reports of the Planetary Geology and Geophysics Program-1985, National Aeronautics and Space Administration Technical Memorandum 88383, p. 591.

[4] Wu, S.S.C., Jordan, Raymond, and Schafer, F.J., 1986, Status of compilation of the Mars 1:2,000,000-scale topographic map series: Reports of the Planetary Geology and Geophysics Program-1985, National Aeronautics and Space Administration Technical Memorandum 88383, p. 618-619.